SEWAGE DISPOSAL PLANT
FOR
WAUKEGAN, ILLINOIS

BY

S. P. WALKER
J. M. EMSLIE
P. F. AUER

ARMOUR INSTITUTE OF TECHNOLOGY

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Design of a sewage disposal
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DESIGN

OF A

SEWAGE DISPOSAL PLANT

FOR

WAUKEGAN ILLINOIS

A THESIS

Presented by

Stephen P. Walker

John M. Emslie

P. Fenton Auer

To The

PRESIDENT AND FACULTY

Of

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1914.

Approved

Alfred E. Phillips Prof Civil Eng.

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H M Raymond

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Preface.

The subject, "The Design Of a Sewage Disposal Plant for Waukegan, Illinois" will be presented in two parts.

In part 1 the general principles and conditions governing the disposal of sewage will be considered.

In part 2 the actual design of the proposed plant for Waukegan, Illinois will be presented.

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PART 1.

Part 1.

The problem of sewage disposal is one of ever increasing importance. The process of sewage disposal has gone from the beginning of the world in an unguided natural manner. As the population becomes more dense, however, it is not safe to disregard it. That the people are cognizant of these facts is shown by the action of the State Boards of Health and by the laws relating to the pollution of streams.

These investigations are necessary for the protection of the public health from the disease germs which are transmitted by raw sewage and for the protection of fish life. Shell fish taken from sewage polluted streams are liable to transmit water born diseases, the germs of which have not been killed in the ordinary method of cooking.

The problem of arranging for the disposal of the sewage of a city is a most serious one from every point of view. It involves a special knowledge, which cannot be found in books, together with a special capacity and a wide ex-

perience. At the same time the necessity for such work and the ability to exercise a proper judgement concerning it, are within the range of the influence of popular discussion as its development in this country has hardly been begun. The problem deals essentially with the elimination of nuisances arising from household and trade wastes which are removed by water carriage.

As was suggested at the beginning of this treatise the problem of the treatment of sewage in works of an artificial nature arises thru the failure of the natural dilution method to meet the local requirements. The disposal of the sanitary wastes should be such that no nuisance will arise from it and that no injury be done to persons or property. These works differ greatly in cost, efficiency, and style of arrangement.

In practical work there are two principles of sewage disposal which should be kept in view. In the first place to prevent offenses to sight and smell the sewage should be discharged at the

sewer outlet in a fresh condition, that is before putrefaction has begun. In the second place to dispose of the disease germs contained in sewage it must be reduced to a state of complete oxidation without the intervention of dangerous or offensive decomposition. To do this without causing a nuisance involves a wide range of conditions. There are naturally important features in common but generally speaking there are characteristics of each plan that should show the adjustment of the design to the particular conditions surrounding it. As to the degrees of purification there are wide differences which have not been recognized but whose importance are becoming more and more appreciated. Obviously the degree of purification in each case should meet the requirements of the statutes to which they are applicable. There are three main aspects also with regard to the public water supplies. The sewage may be treated to the extent of preventing a nuisance and injury to fish life and the water supply taken from the stream thoroughly filtered or the sewage may be thor-

oughly purified before the effluent discharges into a stream from which the water supply is taken without filtration. The third aspect deals with extreme cases in both systems and calls for both thorough purification and filtration.

The objects sought in the disposal of sewage are the removal of all solid matter and objectionable bacteria. With this in view, special provisions should be made for the treatment of storm flows and in a city where there are a number of large factories their wastes should be restricted or especially treated so that the treatment of the resulting mixture can be accomplished by the disposal plant. The percent of purification will depend primarily on the disposition of the effluent. If it is to be discharged into a small stream near a source of water supply a high degree of purification is necessary, whereas if it discharges into a large stream or body of water whose water is filtered before use, the sewage need only be treated to the extent of preventing scum or other objectional matter from collecting on the surface.

These are the two extreme cases in the treatment of sewage. In this country where filtering is used so little the object should be to purify the sewage to a high degree. In Germany and France where all sources of water supply are filtered such purification is not necessary.

Having shown that there are various kinds of problems, it is now necessary to outline the methods of treatment.The first of these is by screens. In one form or another they are used in a majority of plants where sewage is purified. The utility of screens is based on the assumption that certain matter, suspended, may be removed more advantageously in this manner than in other ways. Abroad they are used quite extensively as a preliminary treatment although in this country their principle use is confined to the protection of filters from scum or unsual wear and to the protection of pumps from clogging.There is a growing tendency in this country to make more and better use of screens. Clogging is not serious for centrifugal pumps over eight inches in diameter.

There are three classes of screening arrangements. First coarse gratings having clear openings of from two to six inches, second medium sized bars having from one half to two inch openings, and third fine screens having less than one half inch openings. For sprinkler nozzles screens with one fourth inch openings are recommended and for pumps coarse or medium sized screens. The comparatively coarse matter removed by screens make but a small difference in the purification of sewage. The removal of bacteria is so small as to be negligible.

Sedimentation is another treatment employed in the purification of sewage. The influent is allowed to flow into a basin in which the velocity of flow is reduced, thus permitting the solid matter to be deposited. This is called sludge. Data are meager to show the efficiency of sedimentation. In round numbers however it is safe to say that fifty to seventy-five per cent of the total suspended matter may be deposited. The removal of total organic matter is about half of this amount. The efficiency de-

pends on the time allowed for the sewage to pass thru the basin and this in turn is limited by the fact that if the time of flow thru the basin is made too long, the septic action commences to take place which is undesirable in this type of basin. It has come to the front quite rapidly during the past decade not only as a separate treatment but as an adjunct to filtration. The dissolved matters are sometimes deposited by chemical precipitation. It is usually spoken of as a disinfectant process. This treatment relates essentially to the destruction of objectionable bacteria. It is of aid in the operation of filters for destroying various growths which tend to clog filter surfaces. The cheapest and most efficient coagulant is hypochlorite of lime which combines with the organisms and precipitates them as insoluble nitrates.

Undoubtibly the most important treatment of raw sewage is by septicization which is essentially a biological process of liquefying and gasifying sludge so that the residue may be disposed of without offense as to odors. It

is generally taken to mean a combination of sedimentation and decomposition. One phase relates to the classification of the sewage with a view to an improvement in its composition, the other to the digestion of the sludge to facilitate its disposal. Fron a nygienic standpoint the effluent should not be discharged into a source of unfiltered water water supply without some further form of treatment to remove objectionable bacteria.

As a preliminary treatment for septic tanks where combined sewer systems are used a grit chamber is necessary. Its purpose is to remove such mineral matters as sand and silt from street washings. They are generally constructed in several units each provided with a tile drain along the bottom and so constructed that they may be operated separately and in case of storms all used together. It has beer found by experiment that with an average velocity of flow of one foot per second the sand and silt will be deposited and no organic matter settled.

Septicization in a modern sense dates from

1896 and as a preparation for coarse grained contact filters is of much assistance. In brief the utility of the septic process is closely related to the success with which the sludge and scum are prevented from appearing in the effluent. There are several general types of septic tanks. In the so-called single story tanks the sludge and scum are allowed to remain in the same compartment in which sedimentation takes place. Another type is that in which separate tanks or compartments are provided entirely independent of the sedimentation basin for the specific purpose of disintegrating and rotting the sludge after its removal from the influent. Still another type of tank is the Travis tank. This is a two story tank in which clarification takes place in the upper compartment and septicization in the lower. This type is much less familiar than the Imhoff type and it said that there is more likelihood of odors around this type of tank than the Imhoff tank.

The two story tanks of the Imhoff or

Emscher type stand out conspicuously as the most important step in advance in the art of sewage disposal during the past five years. They have developed a well recognized standing as embodying the most successful steps in the process of preliminary treatment by means of clarification and particularly as to the disposal of sewage sludge in an inoffensive condition at a minimum expense and likelihood of odors. Every reasonable effort is made to confine sedimentation to the upper compartment and septicization of sludge to the lower without interchange from the lower to the upper other than the quiescent displacement of liquid by the solids which settle from the upper to the lower chamber. This type of tank will remove from twenty-five to thirty-five percent of the total organic matter and a somewhat less per cent of the highly putrescible matters.

Imhoff tanks have been built of three distinct types known as radial flow tanks, horizontal flow tanks with rectangular digestion chambers and horizontal flow tanks with circular digestion chambers. The last is the most popular

type in Germany. American Engineers do not take kindly to this design but prefer a type which is rectangular in plan both in top and bottom compartments. As yet there has been practically no experience in this country with the operation of Imhoff tanks.

The Imhoff tank proper consists of a settling chamber suspended over a sludge digestion chamber, the sludge entering the sludge digestion chamber thru slots in the bottom of the settling chamber.The depth of these tanks is usually about thirty feet. It is usually necessary to limit the length of the tank because if made too long the velocity necessary to give the proper detention period will cause whirling currents and thus tend to prevent sedimentation. Hence the length is governed by the length of the detention period and the permissible velocity. With the length determined the required volume will give the cross section area. The flow is usually reversed periodically to secure a more uniform distribution of sludge throughout the sludge chamber hence the inverts must be made at the same elevation and also the in-

fluent and effluent weirs. Baffles are not considered advisable except as flow directors and are being replaced by scumboards. The sludge is discharged most simply and cheaply by means of a pipe reaching nearly to the apex of the conical bottom and having its outlet sufficiently below the water level in the tank so that the sludge is forced out by hydraulic pressure. The sludge is then conveyed to beds of porous material which are provided with the drains where it is dried and is spadable in a few days.

The object of filtration is the removal of suspended matters. It is accomplished in many ways. There are three general types of filters, sprinkling filters, intermittent filters, and contact filters. In sprinkling filters the suspended matter is removed and rendered harmless by aeration or bringing air into intimate contact with all parts of the sewage and thus oxidizing and purifying it. The filter bed is composed of sand stone, clinker or any porous material which will not disintegrate readily.

Intermittent sand filtration consists of applying comparatively small volumns of sewage

to areas of porous sand and allowing it to drain from the pores of the material which fill with air. The dose is repeated some hours later. The sewage being surrounded by air and in the presence of nitrifying organisms which grow in such beds becomes oxidized and the unstable putrescible organic matter becomes converted into stable nitrates resulting in a stable non-putrescible effluent. The sewage is applied to each part of the bed in rotation so no one part is overtaxed. Contact filters are basins filled with coarse materials such as broken stone, glass or coke, to which sewage is applied. The pores of the material fill with air and nitrifying organisms accumulate as with intermittent filters. The doses of sewage are usually applied at eight hour intervals thus allowing the sewage to be in contact with the air and minute organisims for approximately eight hours before it is drained off.

The filling material is covered with a jelly like film which forms a habitat for the reducing and nitrifying micro organisims and helps entangle organic matter by the attractive power

the particles exert on the suspended matter in the sewage. The length of time allowed the sewage in the bed is an important consideration. If too short, sufficient purification will not take place and if too long putrifaction will set in and produce a dark, disagreeable effluent, difficult to purify. Septic tanks are the preliminary treatment usually resorted to in connection with contact beds in order that the sewage be of uniform character. The tank enclosing a contact bed must be water tight and contain a depth of four or five feet of contact material. Contact beds when first put into service have a liquid capacity of about fifty per cent of the total cubical contents of the bed. This is soon cut down to about thirty three per cent due to the growth of organisms, the settling together of the material and insoluble matter entering the beds. The capacity decreases until a point is reached where the material must be cleaned or renewed. This proves the most objectionable and costly feature of this typr of bed. Contact beds are usually oper-

ated in cycles which usually consist of one hour for filling, two hours resting in contact, one hour for draining and four resting empty, making a cycle of eight hours.

PART 2.

Enough has been said to make it plain that there are different problems that can be solved by different treatments in order to meet thoroughly all reasonable sanitary requirements. No settled specifications for design can be followed and so it is necessary to make a study of the local conditions to determine the best method of sewage disposal.

Waukegan, Illinois is located on the southwestern shore of Lake Michigan, about thirty-six miles north of Chicago, and is bordered by North Chicago on the south, Beach on the north. It has a population of sixteen thousand people according to the last census. The main part of the town is located on a bluff which rises to a height of about fifty feet above the lake. A creek passes thru the central part of the town. As shown on the Map of Waukegan at the end of this treatise there are three main outfall sewers which take care of the districts indicated on the map. Those on McKinley and Gillette Avenues take care of sanitary wastes only. Since

for a town of this population it would not be economical to treat the sewage from each system independently it becomes necessary to decide on the best location for and the kind of plant to be installed. The location indicated on the map was decided as best principally on account of the nature of the surrounding property and elevation of the ground.

As the Imhoff tank has demonstrated its superiority over the other types of septic tanks it will be used in connection with contact filters and the effluent discharged into the lake thru the old McKinley Avenue sewer.

A connecting sewer must now be designed to unite the three sewer systems. On the basis of six people per lot of area 150' x 30' requiring an average of 110 gallons per day per capita, a discharge of 382 gallons per second was obtained for the Gillett Avenue sewer, 2194 gallons per second for the main sewer on South Water street exclusive of storm flows and a discharge of 245 gallons per second for the McKinley Avenue sewer.

As Sheridan road was permanently paved a

point on the Gillette Avenue sewer 320 feet east of the center line of Sheridan road was selected as the starting point of the connecting sewer. This sewer runs for a length of 2394 feet down Spring St. at a grade of .244 per cent to an intersection with the main sewer on South Water St. The size of pipe required was obtained from Flynn's tables for the formula $AC\sqrt{r} = \frac{Q}{\sqrt{s}}$ where Q equals the quanity in cubic feet per second and s equals the slope. $\sqrt{s} = .049387$

$$AC\sqrt{r} = \frac{382}{7.5 \times .049387} = 1030$$

For this value a circular sewer having an inside diameter of three feet and nine inches is required.

The main sewer must be designed for storm flows in addition to regular household wastes. For this purpose the rainfall was assumed to be similar to that of Detroit, Michigan whose average rainfalls in inches per six months covering a period of three years are as follows:-

	First Year	Sec. Year	Third Year.
Dec.-May	9.28	10.3	11.32
June.-Nov.	11.82	13.1	14.38
Total	21.1	23.4	25.7

The estimated run off was fifty per cent which gives for a rainfall of five inches in twenty-four hours obtained for the first year quoted above between Dec. and May a run off of

$$\frac{5}{2} \times \frac{(5280)^2 \times 144}{1728 \times 24 \times 3600} = 67$$ cubic feet per second per square mile. The area within the present limits is 4.61 square miles giving a total run off of 4.61 x 67 = 308.5 cubic feet per second. Hence total flow equals 308.5 + 34.4 = 652 cubic feet per second. The slope is 1 in 554 from which $\sqrt{s}$ = .042486 and AC $\sqrt{r} = \frac{Q}{s} = \frac{652}{.042486} = 1532$. From the tables this requires a sewer having an inside diameter of 10 feet and 3 inches. Since it would be useless to design a plant for so great a variable flow this sewer will replace the old sewer discharging into the lake directly and at Market street. A sewer designed to carry a flow equal to that of the household waste flow of both the Gillette Avenue and the main sewer will tap it so that for ordinary discharges all the flow will pass down the Market St. sewer and during storms the excess will jump this opening and discharge directly into the lake, the dilution

being considered sufficiently great to permit the excess to flow directly into the lake. Another sewer will be required to be placed down Market St. which is not permanently paved, to an intersection with the McKinley Avenue sewer. A grade of .15 percent was assumed in order to permit a ten foot siphon under the creek making the elevation, at which the total discharge is collected minus 1.37 feet.

For the Market St. sewer $Q = \frac{2194 + 384}{7.5} = 344$ cubic feet per second. $\sqrt{s} = .208514$

$AC\sqrt{r} = \frac{344}{.208514} = 1650$

This requires a circular sewer having an inside diameter of four feet and five inches.

Although the connecting sewers were made to carry the maximum flow possible within the present city limits it would be a useless waste of capital to design and construct a disposal plant for a population that will not be attained until long after the present methods of sewage disposal have been improved on to such an extent as to render them obsolete, hence it is customary to design such plants for a period of five years in the future. Assuming an increase

of fifty percent within that time, which is ample, or a population of 24000 at 110 gallons per day per capita and assuming that all the sewage flows in a period of eighteen hours instead of twenty-four gives a volume equal to

$$\frac{24000 \times 10}{7.5 \times 18 \times 3600} = 5.43 \text{ cubic feet per second.}$$

The plant to be installed at Waukegan, Illinois will consist of a grit chamber, Imhoff tanks and sludge beds, and single contact filters.

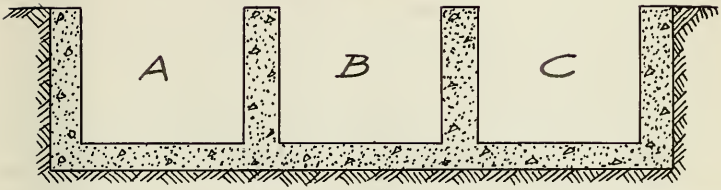
Design of the Grit Chamber.

The sewage is pumped into the grit chamber at the rate of five and one half cubic feet per second. The velocity thru the grit chamber should be about one foot per second since this velocity allows the grit to settle out but carries the sludge on to the Imhoff tanks. It is good practice to make the grit chamber about eighty feet long with an invert of twelve inches. A tank of such dimensions will provide a detention period of from sixty to ninety seconds.

$$A = \frac{Q}{V} = \frac{5\frac{1}{2}}{1} = 5\frac{1}{2} \text{ square feet.}$$

We have a depth of twelve inches and therefore

the width must be five feet and six inches to provide for this area. Three units of exactly the same cross section will be provided. This permits of taking a unit out of operation while it is being cleaned.



For the design of the outside wall consider tank "A" empty. The pressure on the wall will be caused by horizontal thrust of the earth. Take the weight of the earth as 100 pounds per cubic foot and assume one third of this force as acting normal to the wall.

Average pressure on the wall $= \frac{300}{3 \times 2} = 50$ #

Total pressure = 50 x 3 = 150 # acting 1 1/3 ft. from the base.

S for shear = 40 #

S for tension = 40 #

M = 150 x 1 1/3 x 12 = 2400 "#.

V = 150

$t = \frac{150}{40 \times 12} = 3.8"$ say $4"$.

$\frac{M}{S} = \frac{I}{c} = \frac{2400}{40} = 60$

$\frac{I}{c} = \frac{bd^2}{6} = \frac{12 \times d^2}{6}$ Therefore $d = 5\frac{1}{2}"$

A six inch wall will be used.

For the interior walls consider "A" empty and "B" full and design the wall between them. Assume the weight of sewage as 65 # per cubic foot.

Average pressure $= \frac{65 \times 3}{2}$

Total pressure $= \frac{65 \times 3}{2} \times 3 = 293$ #

$M = 293 \times 1\ 1/3 \times 12 = 4688$ "#

$V = 293$ #

$\frac{M}{S} = \frac{bd^2}{6} = \frac{12 \times d^2}{6} = 111$ Therefore $d = 8"$

d for shear $= \frac{293}{40 \times 12} = 7\frac{1}{4}"$

Use a thickness of 8".

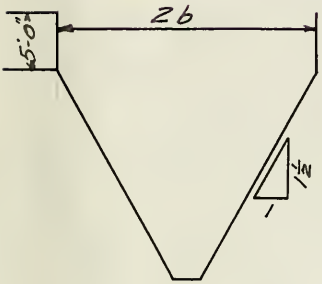
Screens, gates, drains, by-passes etc to be provided for as shown in 2 Of 4.

Design of Imhoff Tanks.

In these tanks a retention period of one and a half hours should be provided.. Hence the required capacity of settling chamber is

$5\frac{1}{2} \times 3600 \times 1\ 1/2 = 29700$ cu.ft.

Cross Section and Length of Settling Chamber..



The velocity thru this chamber is not to exceed .03 feet per second.

$A = \frac{Q}{V} = \frac{5.5}{.03} = 183$

$1\frac{1}{2}b^2 + 10b = 183$

Therefore b = 8" 2b = 16"

Such a width of settling chamber would require too large a tank to get a volumn of 29700 cubic feet so we will use a width of 28'

A 28 x 5 14 x 28 = 532 square feet.

Length of Chamber = $\frac{29700}{532} = 56'$

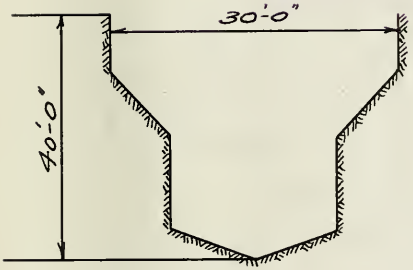
According to Leslie Frank in his design of Imhoff tanks the total depth of tank should be from thirty-five feet to forty feet. The velocity at the influent weir should be at least two feet per second. To insure this velocity in cold wea-

ther a drop of two feet will be provided between the grit chamber effluent and the tank influent.

Design of Tank Walls.

The walls of the settling chamber do not carry a load since the sewage rises to the same height on each side of the wall. A thickness of eight inches with by-rib reinforcing will be used.

Walls for Sludge Chamber.



Consider a section at the base of the wall one foot high.

Total pressure

$40 \times \frac{40 \times 100}{3} = 53333$ #

f = 300 #

$A = \frac{53333}{300} = 180$ square inches.

$b = \frac{180}{12} = 15$ "

Complete design shown on plate 3 of 4.

Design of Sludge Beds.

One square foot of sludge bed will provide for 1.75 persons.

1.75 x 24000 = 42000 square feet required.

It is good practice to make the depth of the main drainage layer 8" and the thickness of the sludge layer 10". According to Fuller 535 square feet of sludge bed will provide for 1000 people. Required area 535 x 24 = 12600 square feet. An area of 15000 square feet will be used. We will provide twelve units.

60'- 0" x 22'- 0" = A = 1320 Total A = 15840

Complete design is shown on plate 4 of 4.

Design of Contact Filters.

The liquid capacity of a contact filter is 33 % of its cubical capacity. A filter cycle is as follows:-

One hour filling.

Two hours full.

One hour draining.

Four hours resting.

Hence a single bed may receive three fillings per day. Filter beds should have a floor gradient of one in one hundred.

Assume 5½ cubic feet per second to leave the septic tanks. This assumption is too high for the sludge has been removed from the sewage

and hence its volume would be reduced from its original value. Cubic feet per day =

$$5\tfrac{1}{2} \times 3600 \times 18 = 356400$$

Filter must have a volume of

$$\frac{356400}{.33} = 1080000 \text{ cubic feet.}$$

A height of five feet will be used. Therefore the area $= \frac{1080000}{5} = 216000$ square feet

Since the filter may be filled three times per day the required area $= \frac{216000}{3} = 72000$ square feet.

Design of Walls.

Assume the weight of the filtering materials to be 110 # per cubic foot, and 1/3 as acting normal to the wall.

$$P = \frac{110 \times 5 \times 5}{3 \times 2} \times .66 = 302 \#$$

Total P = 394 #

M = 394 x 12 x 1 2/3 = 7880 "#

V = 394 #

Thickness for shear $= \frac{394}{40 \times 12} = 10"$

$\frac{M}{S} = \frac{I}{c} = \frac{7880}{40} = 20 = \frac{12d}{6}$ Therefore d = 10"

A thickness of 12" will be used. A complete design of the contact filter beds is shown on plate 4 of 4.

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Auer, Emilie, Walker.

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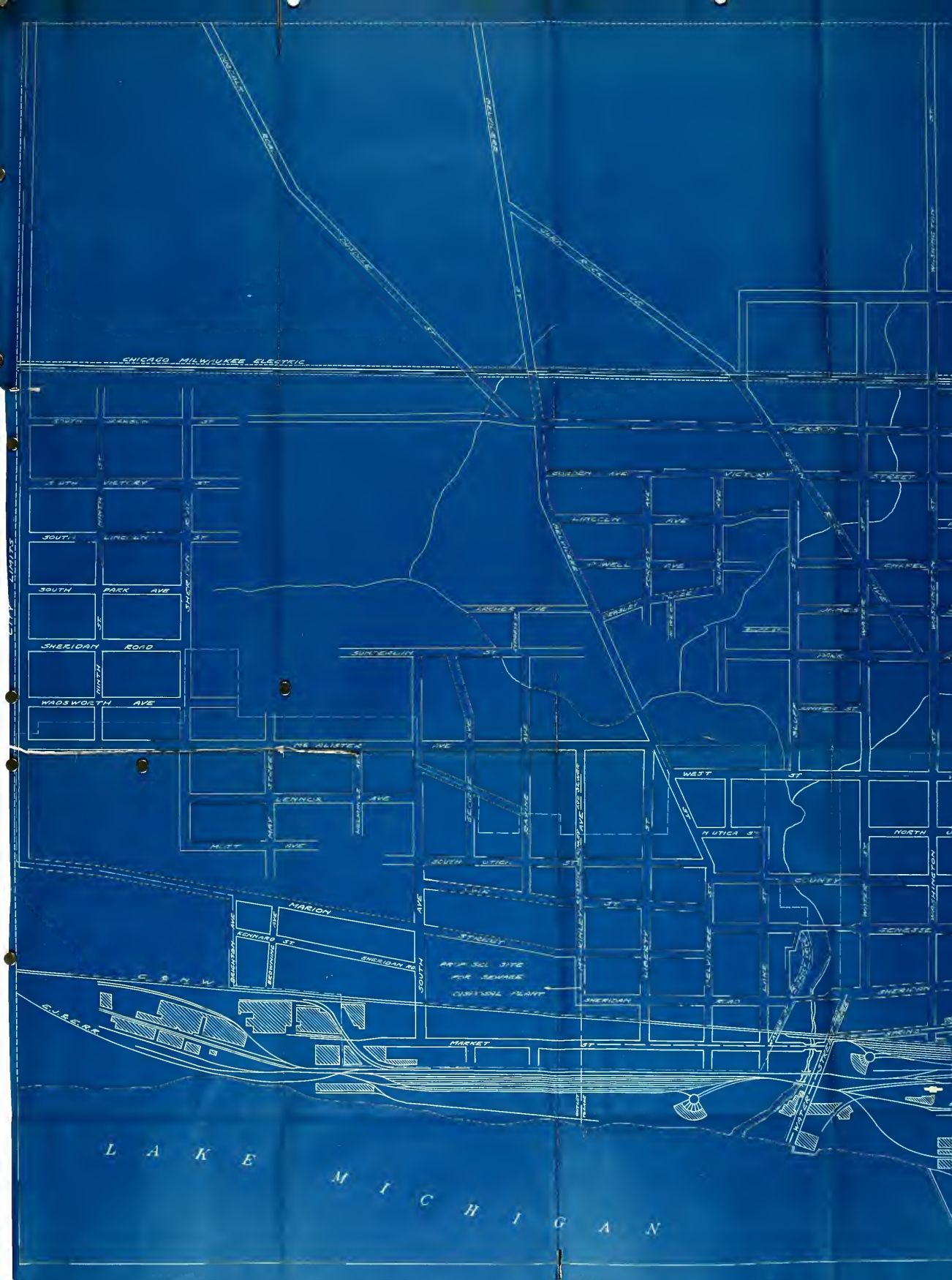
CHICAGO MILWAUKEE ELECTRIC
SOUTH JACKSON ST
SOUTH VICTORY ST
SOUTH LINCOLN ST
SOUTH PARK AVE
SHERIDAN ROAD
WADSWORTH AVE
NINTH ST
SHERIDAN ROAD
CITY LIMITS
JACKSON
GARDEN AVE
VICTORY STREET
LINCOLN AVE
POWELL AVE
CHAPEL
ARCHER AVE
JAMES
SUNDERLAIN ST
PARK
MC ALISTER AVE
WEST ST
LENNOX AVE
MOTT AVE
NUTICA ST
NORTH
SOUTH UTICA ST
COUNTY
MARION
STREET
KENNARD ST
SHERIDAN RD
BRIGHTON AVE
BEGINNING AVE
SOUTH AVE
PROP SEL SITE
FOR SEWAGE
DISPOSAL PLANT
SHERIDAN
ROAD
GENESEE
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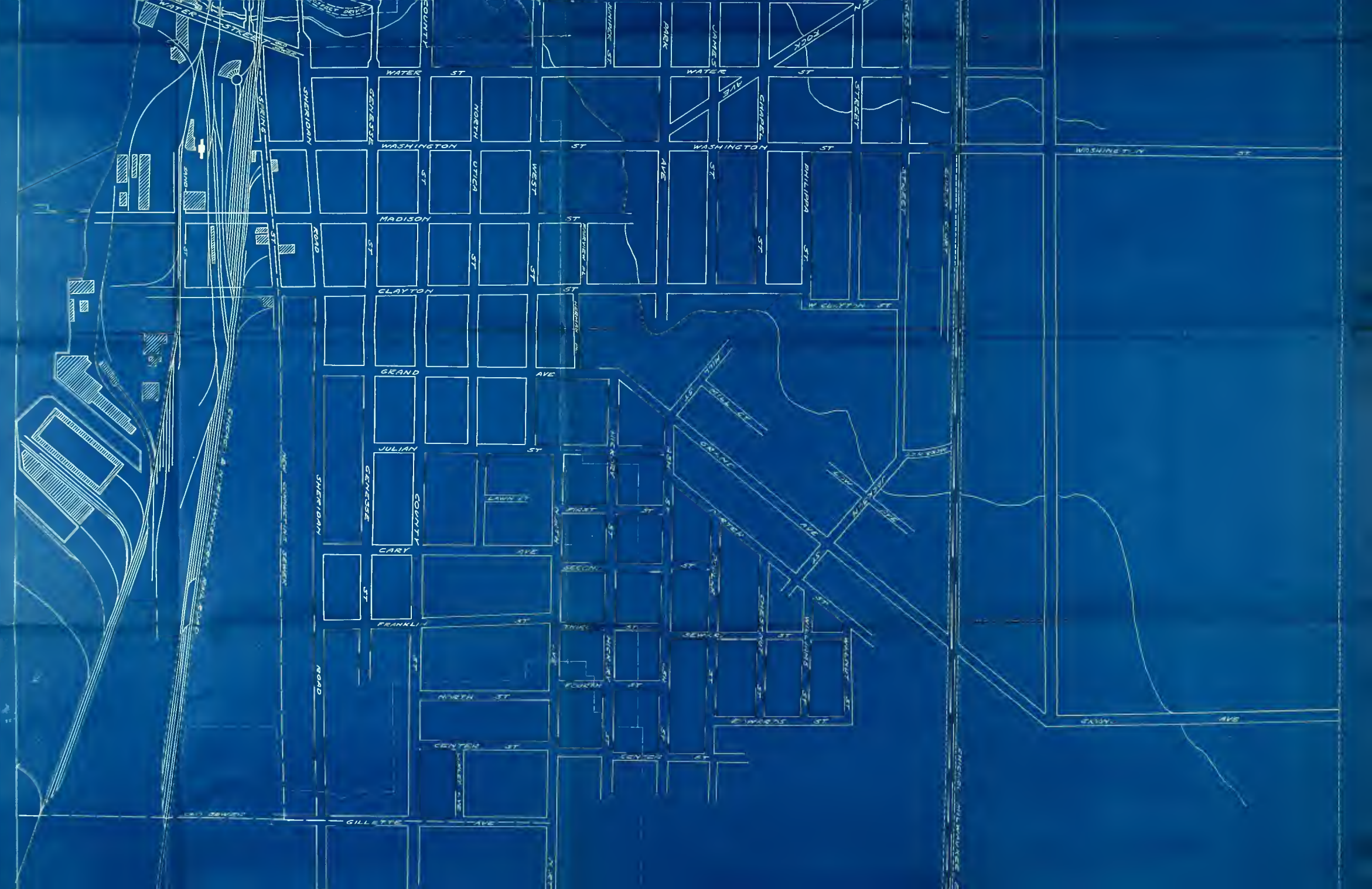
C. & N. W.
C.J.&C.R.R.
MARKET ST
WATER ST
WASHINGTON
LAKE MICHIGAN


WATER STREET
WATER ST
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CLAYTON ST
GRAND AVE
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CARY AVE
FRANKLIN ST
NORTH ST
CENTER ST
GILLETTE AVE
SHERIDAN ROAD
GENESSE COUNTY
NORTH UTICA WEST
PARK
JAMES
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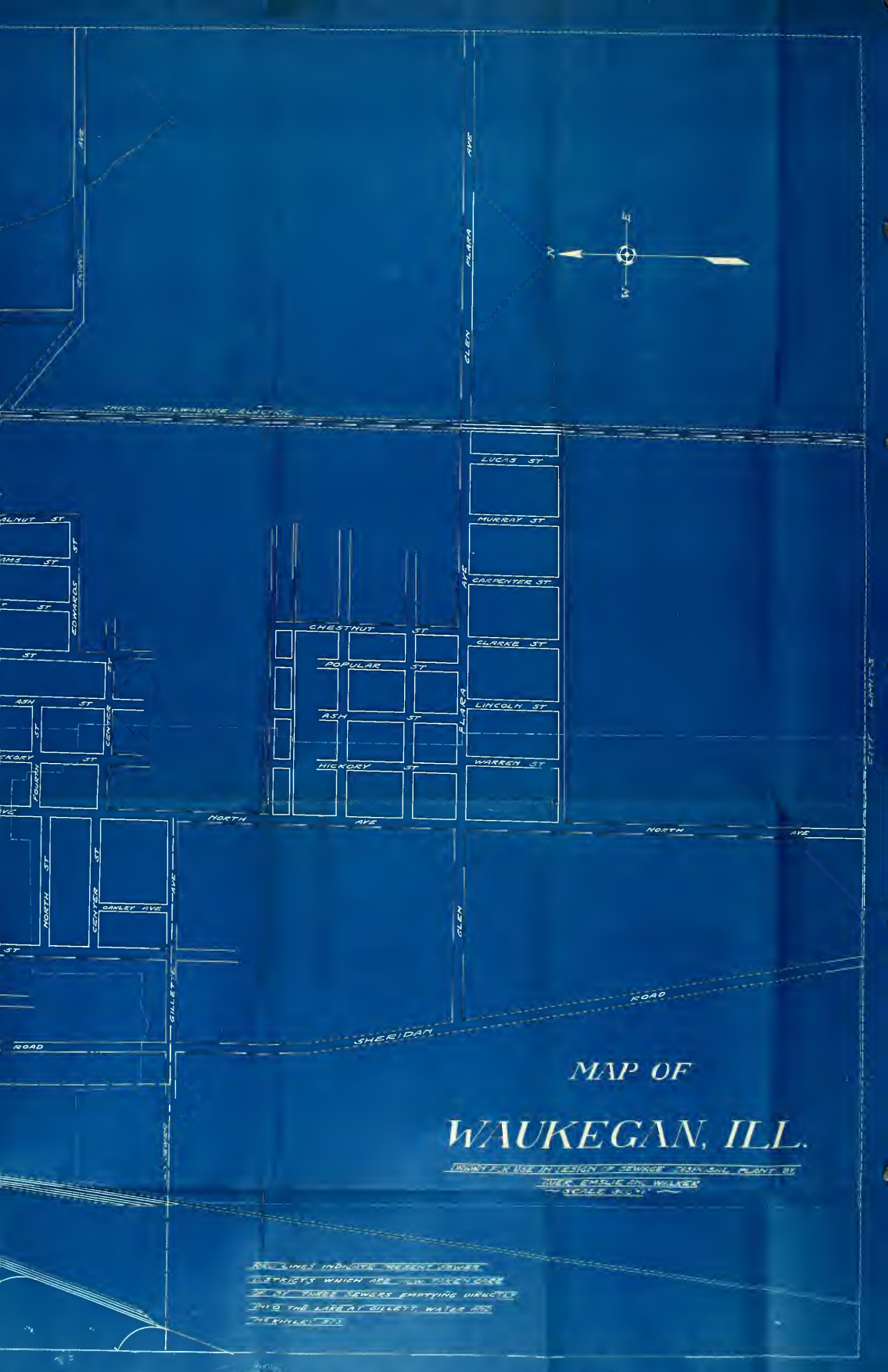
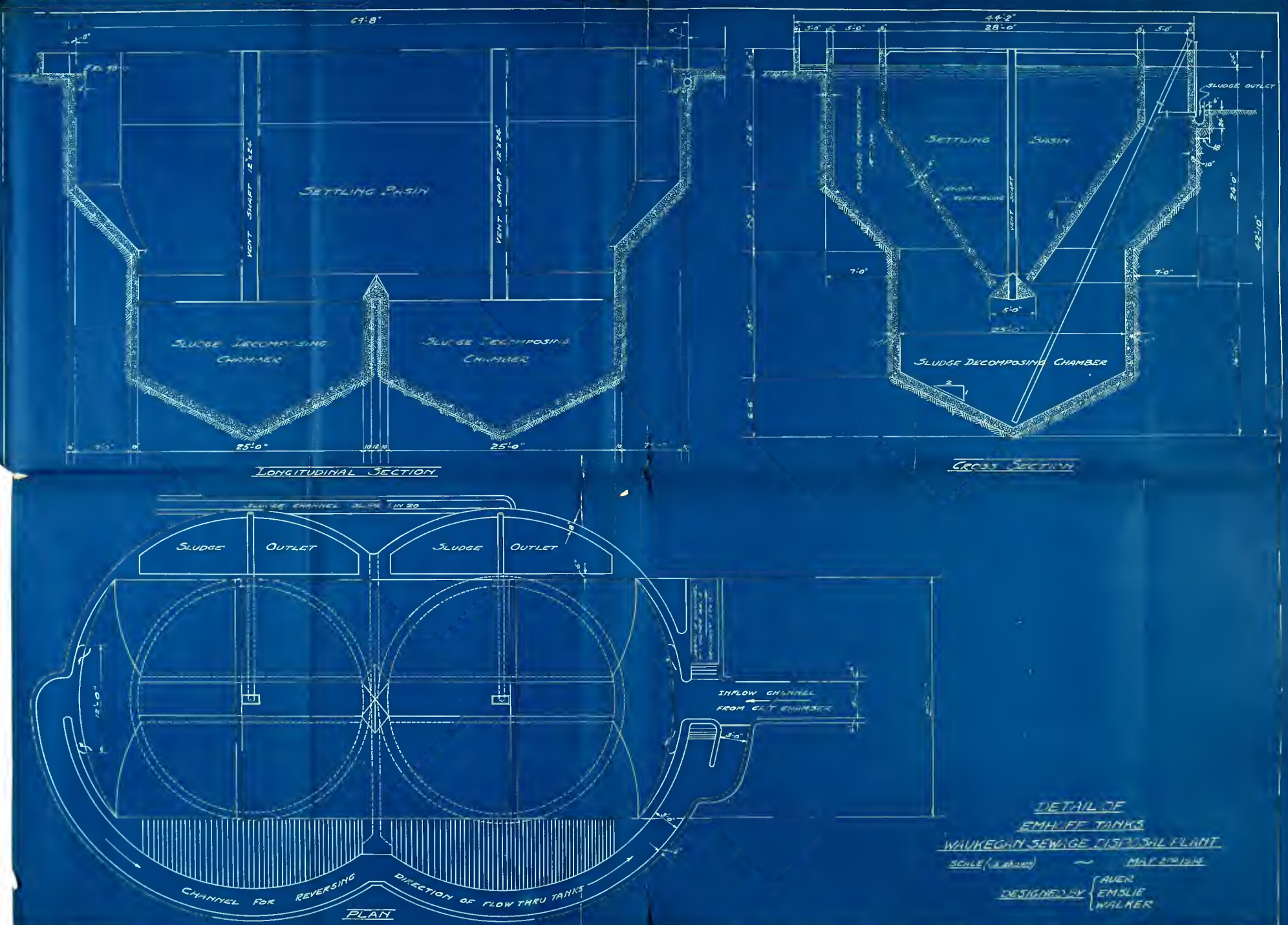
STREET
PHILIPPA ST
W CLAYTON ST
FIRST ST
SECOND ST
THIRD ST
FOURTH ST
SEWER ST
EDWARDS ST
GRAND AVE
LAWN ST
SAND ST
SPRING ST
NEW CONNECTING SEWER
CHICAGO & NORTHWESTERN RAILROAD

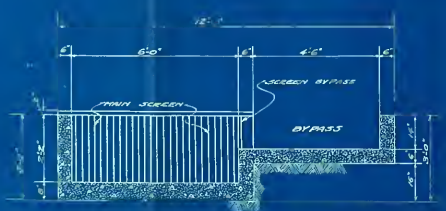

MAP OF
WAUKEGAN, ILL.
DRAWN FOR USE IN DESIGN OF SEWAGE DISPOSAL PLANT BY
HUER EMSLIE AND WALKER
SCALE 1:1000
RED LINES INDICATE PRESENT SEWER DISTRICTS WHICH ARE NOW TAKEN CARE OF BY THREE SEWERS EMPTYING DIRECTLY INTO THE LAKE AT GILLETT, WATER AND McKINLEY STS
CHICAGO MILWAUKEE ELECTRIC
GLEN FLARA AVE
LUCAS ST
MURRAY ST
CARPENTER ST
CLARKE ST
LINCOLN ST
WARREN ST
CHESTNUT ST
POPULAR ST
ASH ST
HICKORY ST
NORTH AVE
NORTH AVE
EDWARDS ST
CENTER ST
FOURTH ST
NORTH ST
CENTER ST
OAKLEY AVE
GILLETT AVE
SHERIDAN ROAD
ROAD
CITY LIMITS
N
E
W



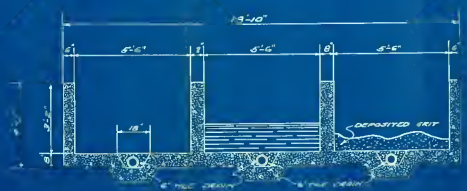
69'-8"
SETTLING BASIN
VENT SHAFT 12"x24"
VENT SHAFT 12"x24"
SLUDGE DECOMPOSING CHAMBER
SLUDGE DECOMPOSING CHAMBER
25'-0"
25'-0"
LONGITUDINAL SECTION
44'-2"
28'-0"
SLUDGE OUTLET
SETTLING BASIN
VENT SHAFT
7'-0"
7'-0"
5'-0"
25'-0"
24'-0"
42'-10"
SLUDGE DECOMPOSING CHAMBER
CROSS SECTION
SLUDGE CHANNEL SLOPE 1 IN 20
SLUDGE OUTLET
SLUDGE OUTLET
INFLOW CHANNEL FROM GRIT CHAMBER
CHANNEL FOR REVERSING DIRECTION OF FLOW THRU TANKS
PLAN
DETAIL OF
EMHOFF TANKS
WAUKEGAN SEWAGE DISPOSAL PLANT
SCALE
MAY 2nd 1914
DESIGNED BY
AUER
EMSLIE
WALKER

LONGITUDINAL SECTION THROUGH CENTER OF GRIT CHAMBER

PLAN OF GRIT CHAMBER



SECTION B-B

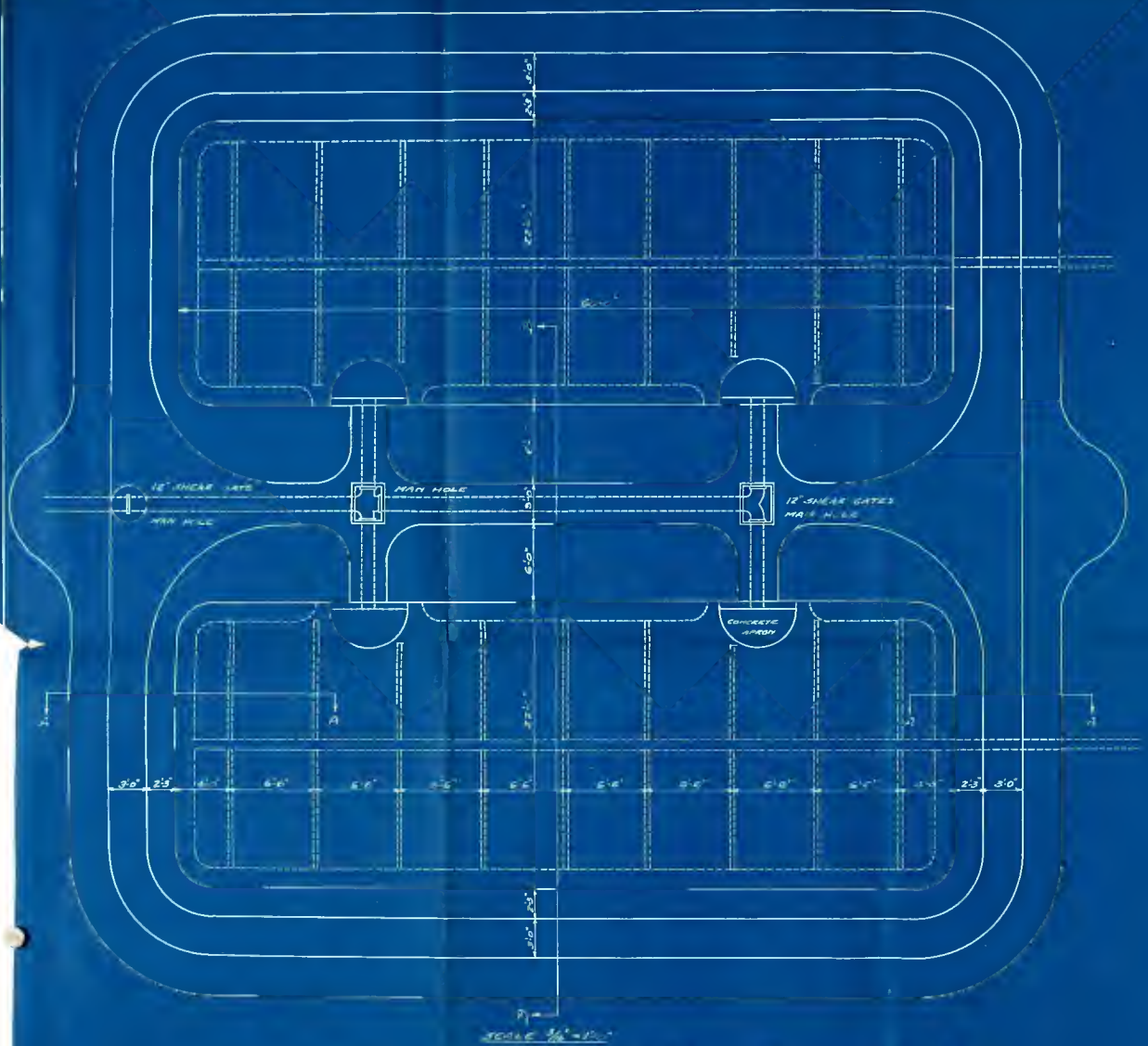


SECTION A-A

DETAIL OF
GRIT CHAMBER FOR
WAUKEGAN SEWAGE DISPOSAL PLANT

SCALE (1/2 INCH) — MAY 13TH 1913

DESIGNED BY { HUEK.
EMSUE.
WALKER.



SCALE 1/8" = 1'-0"

102'-0"
12"
GATE
12"
5'-0"
3'-0"
3'-0"
3